BEFORE THE
PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA

DOCKET NO. 2018-1-E

In the Matter of Annual Review of Base Rates for Fuel Costs for Duke Energy Progress, LLC	))))	**DIRECT TESTIMONY OF** **KELVIN HENDERSON FOR** **DUKE ENERGY PROGRESS, LLC**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Kelvin Henderson and my business address is 526 South Church Street, Charlotte, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am Senior Vice President of Nuclear Operations for Duke Energy Corporation ("Duke Energy") with direct executive accountability for Duke Energy's North Carolina nuclear stations, including Duke Energy Progress, LLC's ("DEP" or the "Company") Brunswick Nuclear Station ("Brunswick") in Brunswick County, North Carolina, the Harris Nuclear Station ("Harris") in Wake County, North Carolina, and Duke Energy Carolinas, LLC's ("DEC") McGuire Nuclear Station, located in Mecklenburg County, North Carolina.

Q. WHAT ARE YOUR RESPONSIBILITIES AS SENIOR VICE PRESIDENT OF NUCLEAR OPERATIONS?

A. As Senior Vice President of Nuclear Operations, I am responsible for providing oversight for the safe and reliable operation of Duke Energy's nuclear stations in North Carolina. I am also involved in the operations of Duke Energy's other nuclear stations, including DEP's Robinson Nuclear Station ("Robinson") located in Darlington County, South Carolina.

Q. PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I have a Bachelor's degree in Mechanical Engineering from Bradley University and over 26 years of nuclear energy experience with increasing responsibilities. My nuclear career began at Commonwealth Edison's Zion Nuclear Station in Illinois

where I received a senior reactor operator license from the Nuclear Regulatory Commission ("NRC") and served as a control room unit supervisor. In 1998, I joined Progress Energy in the operations department at the Harris Nuclear Station. After serving in various leadership roles in Operations, Work Management, and Maintenance, I was named plant manager at Harris. In 2011, I was named general manager of nuclear fleet operations for Progress Energy. Following the Duke Progress merger in 2012, I became site vice president of DEC's Catawba Nuclear Station in York County, South Carolina. In 2016, I was named senior vice president of corporate nuclear, and I assumed my current role as Senior Vice President of Nuclear Operations in December 2017.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to describe and discuss the performance of Brunswick, Harris, and Robinson for the period of March 1, 2017 through February 28, 2018 (the "review period").

Q. YOUR TESTIMONY INCLUDES THREE EXHIBITS. WERE THESE EXHIBITS PREPARED BY YOU OR AT YOUR DIRECTION AND UNDER YOUR SUPERVISION?

A. Yes. These exhibits were prepared at my direction and under my supervision.

Q. PLEASE PROVIDE A DESCRIPTION OF THE EXHIBITS.

A. The exhibits and descriptions are as follows:

Henderson Exhibit 1 - Calculation of the nuclear capacity factor for the review period pursuant to S.C. Code § 58-27-865

Henderson Exhibit 2 - Nuclear outage data for the review period

Henderson Exhibit 3 - Nuclear outage data through the billing period [1]

Q. PLEASE DESCRIBE DEP'S NUCLEAR GENERATION PORTFOLIO.

A. The Company's nuclear generation portfolio consists of approximately 3,543[2] megawatts ("MWs") of generating capacity, made up as follows:

Brunswick - 1,870 MWs

Harris - 932 MWs

Robinson - 741 MWs

Q. PLEASE PROVIDE A GENERAL DESCRIPTION OF DEP'S NUCLEAR GENERATION ASSETS.

A. The Company's nuclear fleet consists of three generating stations and a total of four units. Brunswick is a boiling water reactor facility with two units and was the first nuclear plant built in North Carolina. Unit 2 began commercial operation in 1975, followed by Unit 1 in 1977. The operating licenses for Brunswick were renewed in 2006 by the NRC, extending operations up to 2036 and 2034 for Units 1 and 2, respectively. Harris is a single unit pressurized water reactor that began commercial operation in 1987. The NRC issued a renewed license for Harris in 2008, extending operation up to 2046. Robinson is also a single unit pressurized water reactor that began commercial operation in 1971. The license renewal for Robinson Unit 2 was issued by the NRC in 2004, extending operation up to 2030.

Q. WERE THERE ANY CAPACITY CHANGES WITHIN DEP'S NUCLEAR PORTFOLIO DURING THE REVIEW PERIOD?

[1] This data is provided in confidential and publicly redacted versions for security purposes.
[2] As of January 1, 2018

A. Yes. The replacement of the Harris moisture separator reheater ("MSR") in the fall of 2016 increased the efficiency and capacity of the unit. After seasonal observations and validation testing, the Harris maximum dependable capacity ("MDC") was increased by 4 MWs to 932 MWs effective January 1, 2018. The winter capability rating was also increased, adding 7 MWs to the unit's winter capability.

Q. WHAT ARE DEP'S OBJECTIVES IN THE OPERATION OF ITS NUCLEAR GENERATION ASSETS?

A. The primary objective of DEP's nuclear generation department is to safely provide reliable and cost-effective electricity to DEP's Carolinas customers. The Company achieves this objective by focusing on a number of key areas. Operations personnel and other station employees are well-trained and execute their responsibilities to the highest standards in accordance with detailed procedures. The Company maintains station equipment and systems reliably, and ensures timely implementation of work plans and projects that enhance the performance of systems, equipment, and personnel. Station refueling and maintenance outages are conducted through the execution of well-planned, well-executed, and high quality work activities, which effectively ready the plant for operation until the next planned outage.

Q. PLEASE DISCUSS THE PERFORMANCE OF DEP'S NUCLEAR FLEET DURING THE REVIEW PERIOD.

A. The Company operated its nuclear stations in a reasonable and prudent manner during the review period, providing approximately 47% of the total power generated by DEP. The four nuclear units operated at an actual system average capacity factor

of 94.60% during the review period. During calendar year 2017, DEP's nuclear fleet recorded the second highest annual net generation in DEP's history, producing just over 29,504 GWHs and falling just below the record established in 2014. Harris set a new net output record during the year, producing just over 8,208 GWHs surpassing the prior record established in 2011. The Brunswick station, with annual net generation of just over 15,370 GWHs recorded the second best production in the station's history, falling just below the record established in 2016.

As shown on Henderson Exhibit 1, DEP achieved a net nuclear capacity factor, excluding reasonable outage time, of 101.66% for the review period. This capacity factor is above the 92.5% set forth in S.C. Code § 58-27-865(F), which states in pertinent part:

> There shall be a rebuttable presumption that an electrical utility made every reasonable effort to minimize cost associated with the operation of its nuclear generation facility or system, as applicable, if the utility achieved a net capacity factor of ninety-two and one-half percent or higher during the period under review. The calculation of the net capacity factor shall exclude reasonable outage time associated with reasonable refueling, reasonable maintenance, reasonable repair, and reasonable equipment replacement outages; the reasonable reduced power generation experienced by nuclear units as they approach a refueling outage; the reasonable reduced power generation experienced by nuclear units associated with bringing a unit back to full power after an outage....

The performance results discussed above support DEP's continued commitment for achieving high performance without compromising safety and reliability.

Q. WHAT IMPACTS A UNIT'S AVAILABILITY AND WHAT IS DEP'S PHILOSOPHY FOR SCHEDULING REFUELING AND MAINTENANCE OUTAGES?

A. In general, refueling requirements, maintenance requirements, prudent maintenance practices, and NRC operating requirements impact the availability of DEP's nuclear system. Prior to a planned outage, DEP develops a detailed schedule for the outage and for major tasks to be performed including sub-schedules for particular activities.

The Company's scheduling philosophy is to plan for a best possible outcome for each outage activity within the outage plan. For example, if the "best ever" time a particular outage task was performed is 10 days, then 10 days or less becomes the goal for that task in each subsequent outage. Those individual goals are incorporated into an overall outage schedule. The Company aggressively works to meet, and measures itself against, that schedule. Further, to minimize potential impacts to outage schedules, "discovery activities" (walk-downs, inspections, etc.) are scheduled at the earliest opportunities so that any maintenance or repairs identified through those activities can be promptly incorporated into the outage plan. Those discovery activities also have pre-planned contingency actions to ensure that, when incorporated into the schedule, the activities required for appropriate repair can be performed as efficiently as possible.

As noted, the Company uses the schedule for measuring outage planning and execution, and driving continuous improvement efforts. However, in order to provide reasonable, rather than best ever, total outage time for planning purposes, particularly with the dispatch and system operating center functions, DEP also

develops an allocation of outage time which incorporates reasonable schedule losses. The development of each outage allocation is dependent on maintenance and repair activities included in the outage, as well as major projects to be implemented during the outage. Both schedule and allocation are set aggressively to drive continuous improvement in outage planning and execution.

Q. HOW DOES DEP HANDLE OUTAGE EXTENSIONS AND FORCED OUTAGES?

A. When an outage extension becomes necessary, DEP believes that work completed in the extension results in longer continuous run times and fewer forced outages, thereby reducing fuel costs in the long run. Therefore, if an unanticipated issue that has the potential to become an on-line reliability issue is discovered while a unit is off-line for a scheduled outage and repair cannot be completed within the planned work window, the outage is usually extended to perform necessary maintenance or repairs prior to returning the unit to service. In the event that a unit is forced off-line, every effort is made to safely perform the repair and return the unit to service as quickly as possible.

Q. DOES DEP PERFORM POST-OUTAGE CRITIQUES AND CAUSE ANALYSES FOR INTERNAL IMPROVEMENT EFFORTS?

A. Yes. The nuclear industry recognizes that constant focus on operational excellence results in improved nuclear safety and reliability. As such, DEP applies self-critical analysis to each outage to identify every potential cause of an outage delay or event resulting in a forced or extended outage. These critiques and cause analyses do not

document the broader context of the outage or event, and thus rarely reflect strengths and successes.

Q. **WHAT IS THE RELATIONSHIP BETWEEN THE STANDARDS THAT THE COMPANY APPLIES IN ITS POST OUTAGE CRITIQUES AND THE "EVERY REASONABLE EFFORT" STANDARD OF SECTION 58-27-865?**

In our outage evaluations we are looking closely for any opportunity for improvement. We are not assessing the "reasonableness" of any conduct or actions that might have contributed to the outage. Reasonableness focuses on what was done in light of what was known prior to the event; in our outage evaluations we are focused on learning and applying new lessons from our experiences in order to improve our operations. The fact that an outage investigation may indicate ways we can improve our future operations does not indicate that we have determined that our previous practices did not meet the reasonableness standard.

Q. WHAT REFUELING OUTAGES WERE REQUIRED AT DEP'S NUCLEAR FACILITIES DURING THE REVIEW PERIOD?

A. There were two refueling outages completed during the review period: Brunswick Unit 2 and Robinson. The Robinson refueling outage began in late February just prior to the beginning of the review period.

The Robinson refueling outage began on February 25, 2017 and concluded on April 18, 2017. In addition to refueling and maintenance activities, significant outage scope included generator and turbine work. The main generator stator was replaced during the unit shutdown and a total of 200 blades were replaced in the low pressure turbines. Sludge lancing was completed on the secondary side and Eddy

Current testing was completed on all three steam generators. Other safety and reliability enhancements included modifications to the Plant Freeze Protection System and service water piping replacements in the turbine building. Electrical work completed included the replacement and modification of 11 4KV breakers, replacement of an obsolete Motor Control Center Breaker, and replacement of the station service transformer that supplies the 'A' train emergency bus. The outage was completed in 42 days against a planned allocation of 48 days.

Brunswick Unit 2 began a refueling outage on March 17, 2017. In addition to refueling and maintenance activities, safety and reliability enhancements were completed. Work on the emergency diesel generator number 4 included replacement of the governor and timing relays, and installation of an automatic voltage regulator and jet air assist system. Switchyard reliability improvements included open phase relay protection modifications to both the start-up ("SAT") and auxiliary transformers ("UAT"). Upgraded coating was applied to the Non-Seg bus ducts for both the SAT and UAT, and the Wallace 230 kV line relay panel was upgraded. Inspections and repairs were completed on the 'A' and 'B' low pressure turbines and a main generator exciter water cooled diode bridge modification was completed. Fukushima related modifications included the installation of a harden containment vent on Unit 2, and the installation of fire hose pressure reducing valves. Ten year interval in-service ("ISI") and non-destructive evaluations ("NDE") testing was completed. During startup activities, turbine vibrations extended the outage by 1.8 days above allocation. After the turbine issues were corrected, the unit returned to service on April 17, 2017. On April 18, 2017, the unit

was removed from service for just under two hours to complete turbine overspeed testing.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes, it does.

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR CAPACITY FACTOR PURSUANT TO S.C. CODE ANN. § 58-27-865(F)
REVIEW PERIOD OF MARCH 2017 THROUGH FEBRUARY 2018

1	Nuclear System Actual Net Generation During Review Period	29,332,839	MWH
2	Total Number of Hours during Review Period	8,760	
3	Nuclear System MDC during Review Period	3,539.67	MW
4	Reasonable Nuclear System Reductions	2,153,451	MWH
5	Nuclear System Capacity Factor ((L1/(L2a*L3a)-L4)*100	101.66	%

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE DATA FOR REVIEW PERIOD OF
MARCH 2017 THROUGH FEBRUARY 2018

Nuclear outages lasting one week or more during the Review Period

Station/Unit	Date of Outage	Explanation of Outage
Robinson 2 [1]	3/1/2016 - 4/8/2017	Scheduled Refueling - EOC 30
Brunswick 2	3/17/2017 - 4/17/2017	Scheduled Refueling - EOC 23

[1] Outage began on 2/25/2017 just prior to the beginning of the review period.

DUKE ENERGY PROGESS, LLC
SOUTH CAROLINA ANNUAL REVIEW OF BASE RATES FOR FUEL COSTS
NUCLEAR OUTAGE SCHEDULE THROUGH PROJECTED AND BILLING PERIOD
MARCH 2018 THROUGH JUNE 2019

Scheduled nuclear outages lasting one week or more through the Billing Period

Station/Unit	Date of Outage[1]	Explanation of Outage

REDACTED

[1] This exhibit represents DEP's current plan, which is subject to change based on fluctuations in operational and maintenance requirements.